(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 568 742 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **92304172.7**

(22) Date of filing: **08.05.92**

(51) Int. Cl.5: **F04B 9/10**, F04F 1/08, F04F 1/10

(43) Date of publication of application:
10.11.93 Bulletin 93/45

(84) Designated Contracting States:
DE FR GB NL

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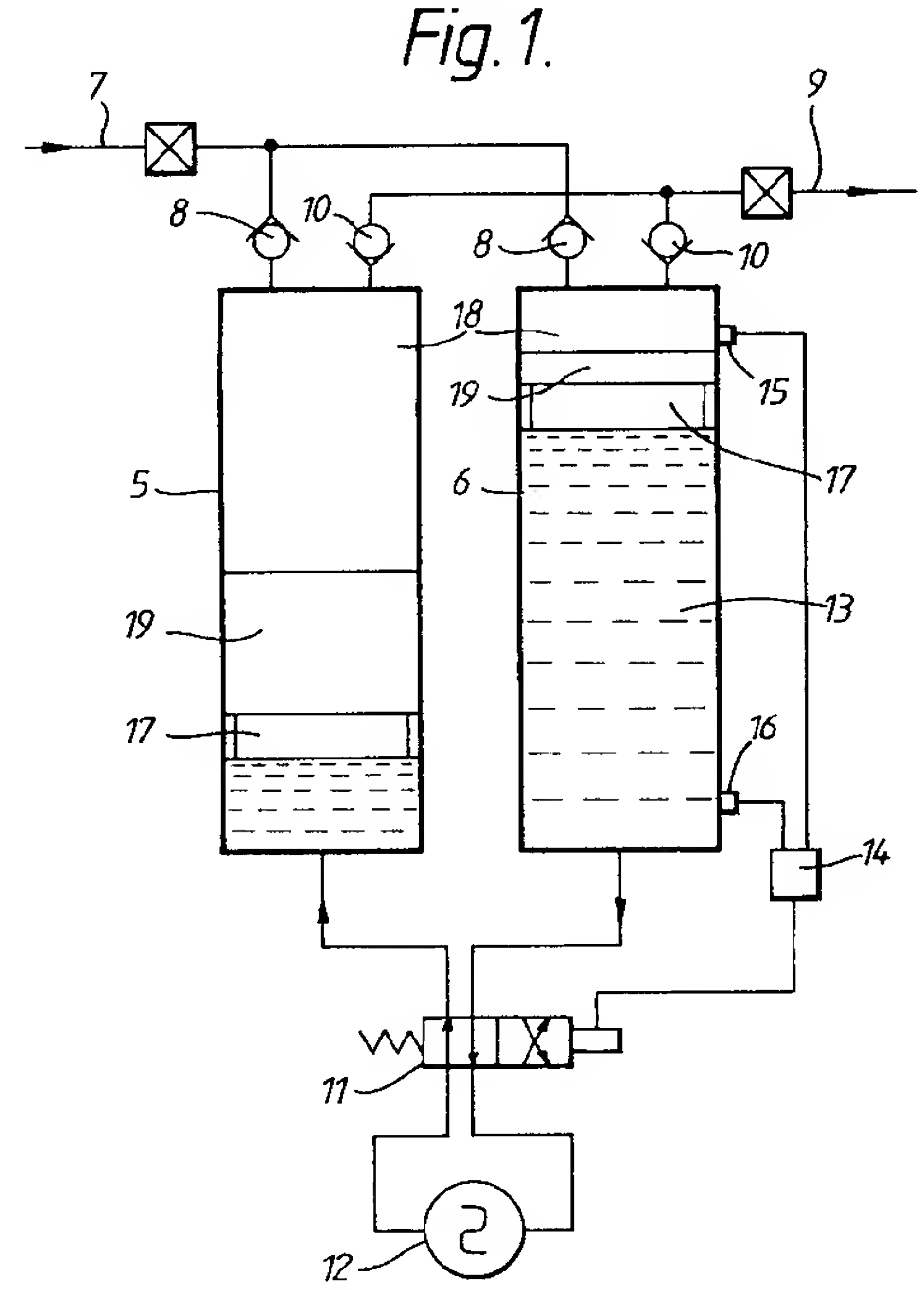
(54) Transfer of production fluid from a well.

(57) The flow of a multi-flow liquid phase liquid/gas production fluid from an oil well is boosted by alternately introducing the production fluid into a chamber (5,6) and thereafter expelling it from the chamber by displacement by a liquid (13) which can be pumped by a conventional single phase liquid pump.

Fig. 1.



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It is frequently necessary to boost the transfer of production fluid from an oil well. For example the well may be a very long way from an export point, such as the deck of a platform or landfall, in the case of a subsea well, and the pressure drop in the correspondingly long pipeline may reduce the flow rate to an unacceptable level. A similar problem arises when there is insufficient reservoir pressure to achieve an acceptable flow rate through a wellhead to an export point. Oil tapped from an oil well is invariably accompanied by a gaseous component which will increasingly come out of solution with reduced pressure. The result is that the production fluid, the transfer of which is to be boosted, will incorporate liquid and gaseous phases in indeterminate and widely varying proportions ranging from slugs of liquid oil through frothy mixtures to pockets of gas.

Pumping such multiphase fluid is difficult because pumps that can pump liquids efficiently and ones that can pump gases efficiently have two different sets of characteristics and these have yet to be combined successfully in a single reliable pump. The alternative is to allow gravitational or centrifugal separation of the different phases and then to pump or otherwise feed the liquid and gaseous phases separately. The provision of large settling tanks is awkward and expensive, particularly for subsea operation, and two feeder lines have to be provided, one for the pumped gas and one for the pumped liquid.

In accordance with the present invention, a method of transferring production fluid incorporating liquid and gaseous phases from a well to an export point comprises providing two chambers each connected at their upper parts via valving with both a supply of the production fluid from the well and with a feeder for the production fluid to the export point; and introducing a liquid of specific gravity greater than that of the production fluid into the lower part of each chamber in turn to displace fluid out of that chamber into the feeder while allowing production fluid to flow from the supply into the other chamber.

Utilizing this novel method, production fluid incorporating liquid and gaseous components in indeterminate and variable proportions can be pumped into a single feeder line by the introduction into the lower parts of the chambers of a liquid from a high pressure source or by the action of a conventional single phase liquid pump. The equipment is therefore comparatively simple and may be used in many locations, for example downhole, in a silo on the sea bed, at an intermediate station in a pipeline, or integrated with a completion wellhead.

The liquid may be alternately pumped from the lower part of one chamber into the lower part of the other chamber and vice versa. The liquid may then be a residual body of a liquid such as water which is pumped to and fro between the chambers, the upper surface of the liquid in the chamber into which the liquid is being pumped, effectively acting as a piston face which forces the production fluid above out of the chamber into the feeder.

Alternatively, the liquid may be a component of the production fluid, particularly oil. Inevitably some settlement of the oil from the rest of the production fluid will occur in the chambers so that when the liquid oil is being pumped from the lower part of one chamber into the lower part of the second chamber, and the production fluid is entering the upper part of the one chamber, some of the liquid oil being pumped from the one chamber will be replenished by settlement from the production fluid entering that chamber, perhaps for a considerable time if the production fluid at that time is high in liquid content. This mode of pumping from the one chamber to the second chamber will continue until the level of liquid in the one chamber approaches the bottom of the one chamber, whereupon the pumping mode will changeover to one in which the liquid oil is pumped from the lower part of the second chamber to the lower part of the one chamber.

The pump, which may be an electric or hydraulic pump, need not be reversed on mode changeover if there is interposed between the pump and the chambers valving, such as a two position spool valve, which alternately connects the chambers to the upstream and downstream sides of the pump.

Instead of pumping the liquid between the two parts of the chambers, the fluid introduced into the lower parts of the two chambers may be derived from a source of high pressure liquid, such as a high pressure water injection line, probably already present in the vicinity for other purposes, such as downhole injection. Valving, again such as a similar two position spool valve, may be interposed between the high pressure line and the chamber to enable water to be supplied to the lower parts of the two chambers alternately, while the lower part of the other chamber is vented.

The use of a high pressure water injection line for boosting the production fluid flow in this way will normally occur subsea, adjacent to the mudline. In that case, very little extra energy, if any, is required to boost the flow as the head of water in the water injection line down to the sea bed will normally be greater than the corresponding head of lighter production fluid flowing up through the sea to a platform or landfall.

In all cases the spool valve or other means for changing over from the introduction of the liquid into one chamber to the introduction of the liquid into the other chamber may be controlled by sens-

ing the level of the liquid in at least one of the chambers. Essentially this will involve a high and low level sensor for at least one chamber or two low or high level sensors, one for each chamber, thereby ensuring that a residual body of liquid remains in the lower part of each chamber at any time. The sensors may be of any conventional type, such as distance or density sensors which are appropriately coupled to the chamber or chambers to detect an interface between the residual body of liquid and the production fluid above. The sensors may operate the changeover valving either electrically, for example by a solenoid, or passively using hydraulic pilot pressure.

An example of a system for carrying out the method in accordance with the present invention is illustrated diagrammatically in the accompanying drawings, in which:

Figs. 1 and 2 show one system in the alternate modes of operation, respectively; and,

Figs. 3 and 4 correspond to Figs. 1 and 2 but show a modification of the system.

The system shown in Figs. 1 and 2 has two chambers provided by vessels 5 and 6, each of which is connected at its upper end both to a common production fluid supply line 7 via a non-return valve 8, and to a common production fluid feeder line 9 via a non-return valve 10. At its bottom each chamber is connected with the other via a two-way spool valve 11 and a pump 12. A residual body of liquid 13 occupies parts of both chambers and can be pumped from one to the other by the pump 12 in a direction depending upon the position of the valve 11. The valve is changed over by a controller 14 in response to high and low sensors 15 and 16 which respond to the surface level of the liquid 13 in the chamber 6. Floats 17 are provided in the chambers and have a density to float on top of the respective surfaces of the liquid 13. Although these floats may incorporate some magnet or other device to cooperate with the sensors 15 and 16, they are primarily provided so that the liquid component of production fluid falling into the chambers will not unnecessarily disturb the surface level of the liquid 13.

Fig. 1 shows the valve 11 set so that, as shown by the arrows, the liquid 13 is being pumped from the chamber 6 into the chamber 5. As this happens production fluid is drawn from the line 7 into the top of chamber 6 and may begin to separate into an upper gaseous phase 18, and an intermediate frothy partially liquid and partially gaseous phase 19. If the liquid 13 is, for example, water, there may be an additional liquid oil phase below the phase 19. However, in the present case it is assumed that the liquid phase in the production fluid will be oil as will be the liquid 13, so that any truly liquid oil which settles out will drain past the float 17 into the liquid body 13.

Simultaneously, the rising level of liquid 13 in the chamber 5 will displace the various phases of previously drawn in production fluid out through the respective valve 10 and into the feeder line 9.

When the sensor 16 senses that the level of liquid 13 has dropped to the appropriate lower level, the controller 14 will changeover the valve 11 so that the reverse mode, illustrated in Fig. 2, commences. During that mode the various phases of production fluid previously drawn into the chamber 6 will be forced out into the feeder line 9 whilst production fluid will be drawn into the top of the chamber 5.

This will continue until the sensor 15 senses that the level of liquid 13 has risen to the appropriate upper level in the chamber 6, whereupon the controller 14 will change the valve 11 back again so that the mode illustrated in Fig. 1 recommences and the cycle is repeated.

Figs 3 and 4 show a modification in which the pump 12 is replaced by a connection to a high pressure water injection line 20. Depending on the position of the valve 11, the high pressure water 21,21A will be forced into the bottom of one or other of the chambers 5,6, while the water previously forced into the other chamber in the previous cycle is released to a suitable low pressure sump, e.g. a water injection well, via a line 22. The changeover of the valve 11 by the controller 14 will be triggered by the upper level sensor 15 for the chamber 6, or an upper level sensor 23 for the chamber 5 sensing the interface of the rising body of water 21A or 21 respectively.

Claims

1. A method of transferring a production fluid incorporating liquid and gaseous components from a well to an export point, the method comprising providing two chambers (5,6) each connected at their upper parts via valving (8,10) with both a supply (7) of the production fluid from the well and with a feeder (9) for the production fluid to the export point; and introducing a liquid (13,21) of specific gravity greater than that of the production fluid into the lower part of each chamber in turn to displace fluid out of that chamber into the feeder while allowing production fluid to flow from the supply into the other chamber.

2. A method according to claim 1, in which the liquid is alternately pumped from the lower part of one chamber into the lower part of the other chamber and vice versa.

3. A method according to claim 1 or claim 2, in which the liquid is a component of the production fluid.

4. A method according to claim 1 or claim 2, in which the liquid is water.

5. A method according to claim 4 when dependent on claim 1, in which the water is provided from a high pressure water injection line (20) .

6. A method according to any one of the preceding claims, in which the changeover from introducing the liquid into one chamber to introducing the liquid into the other chamber is controlled by sensing (15,16) the level of the liquid in at least one of the chambers.

Fig. 2.

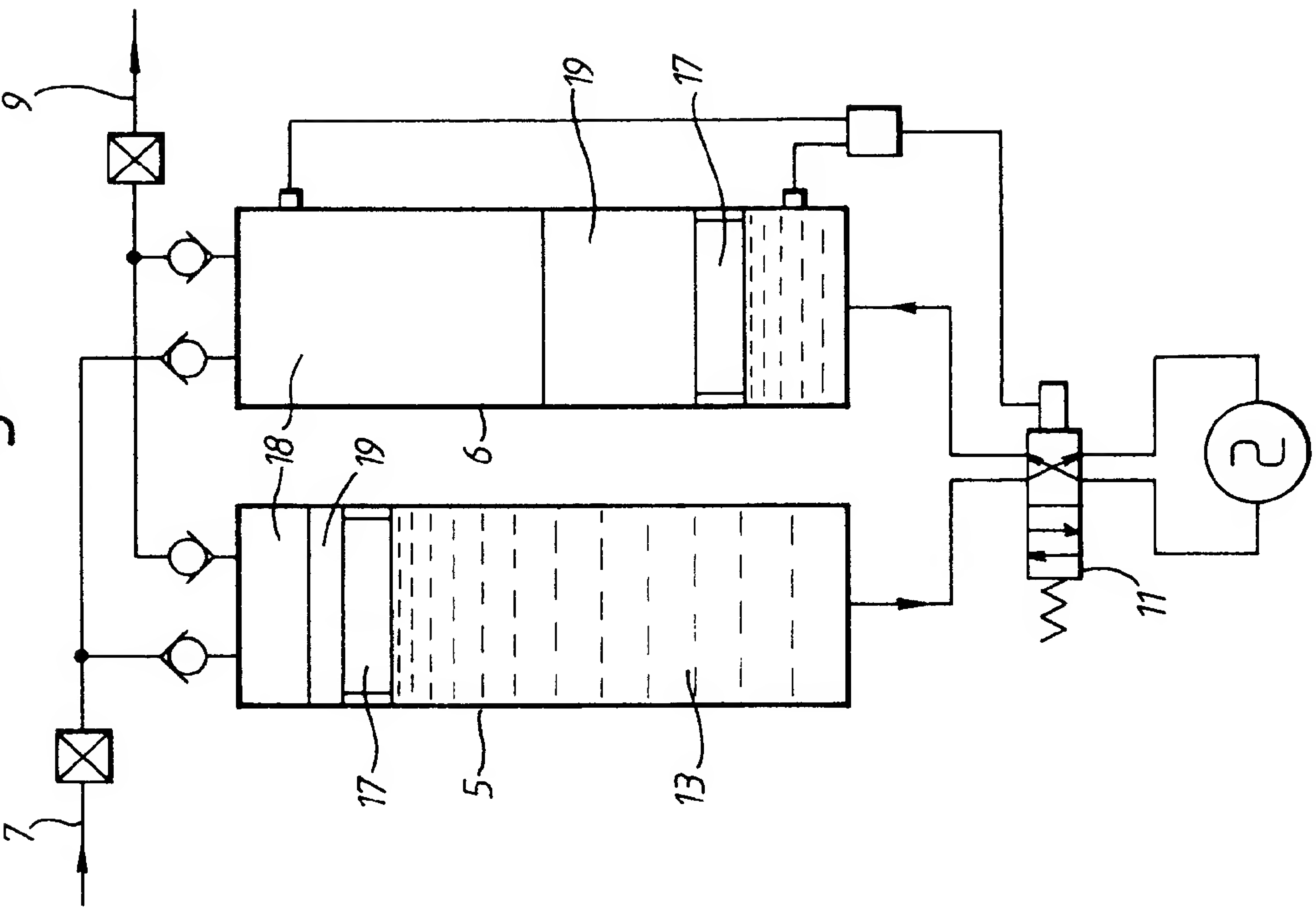
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Fig. 1.

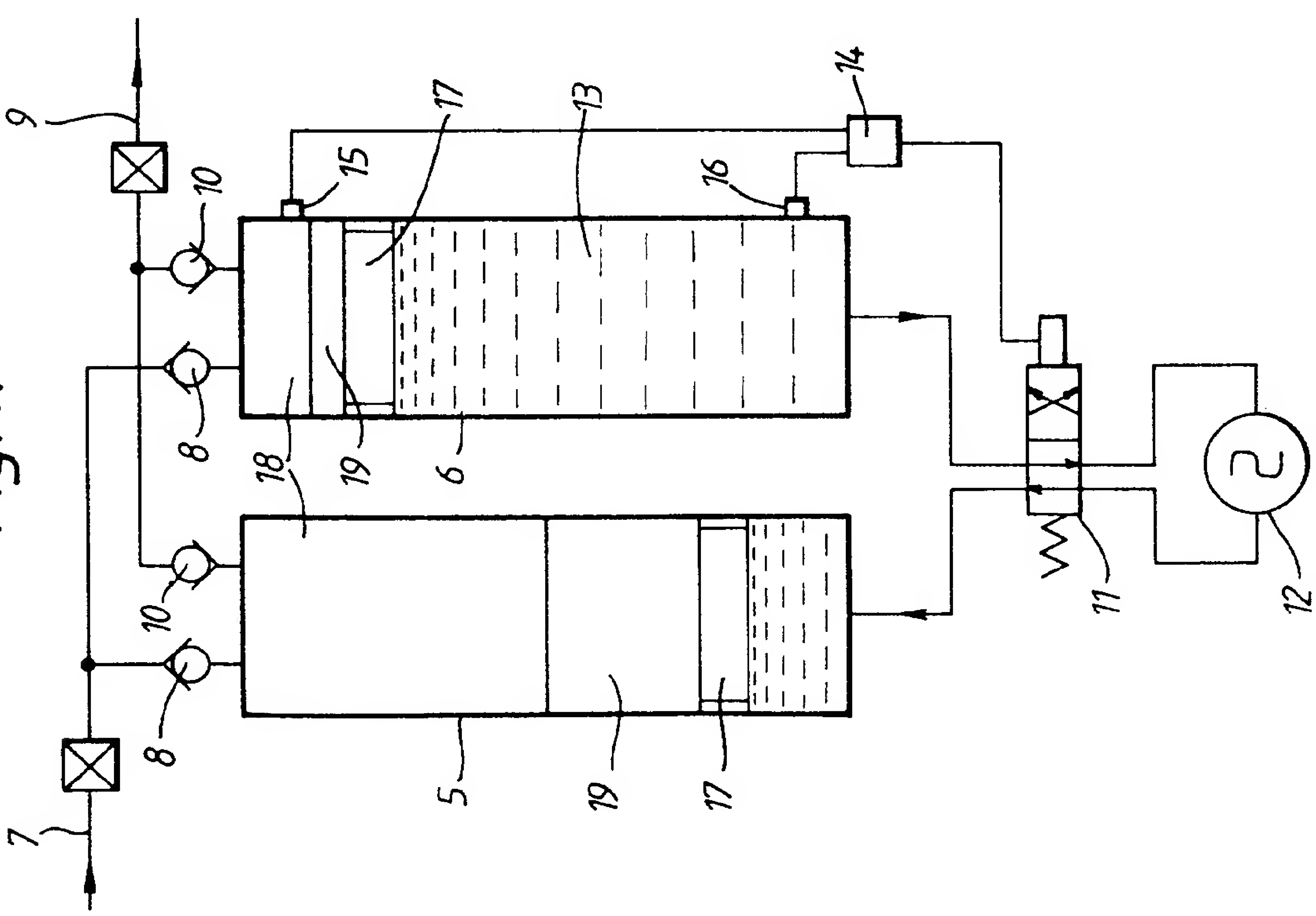
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Fig.4.

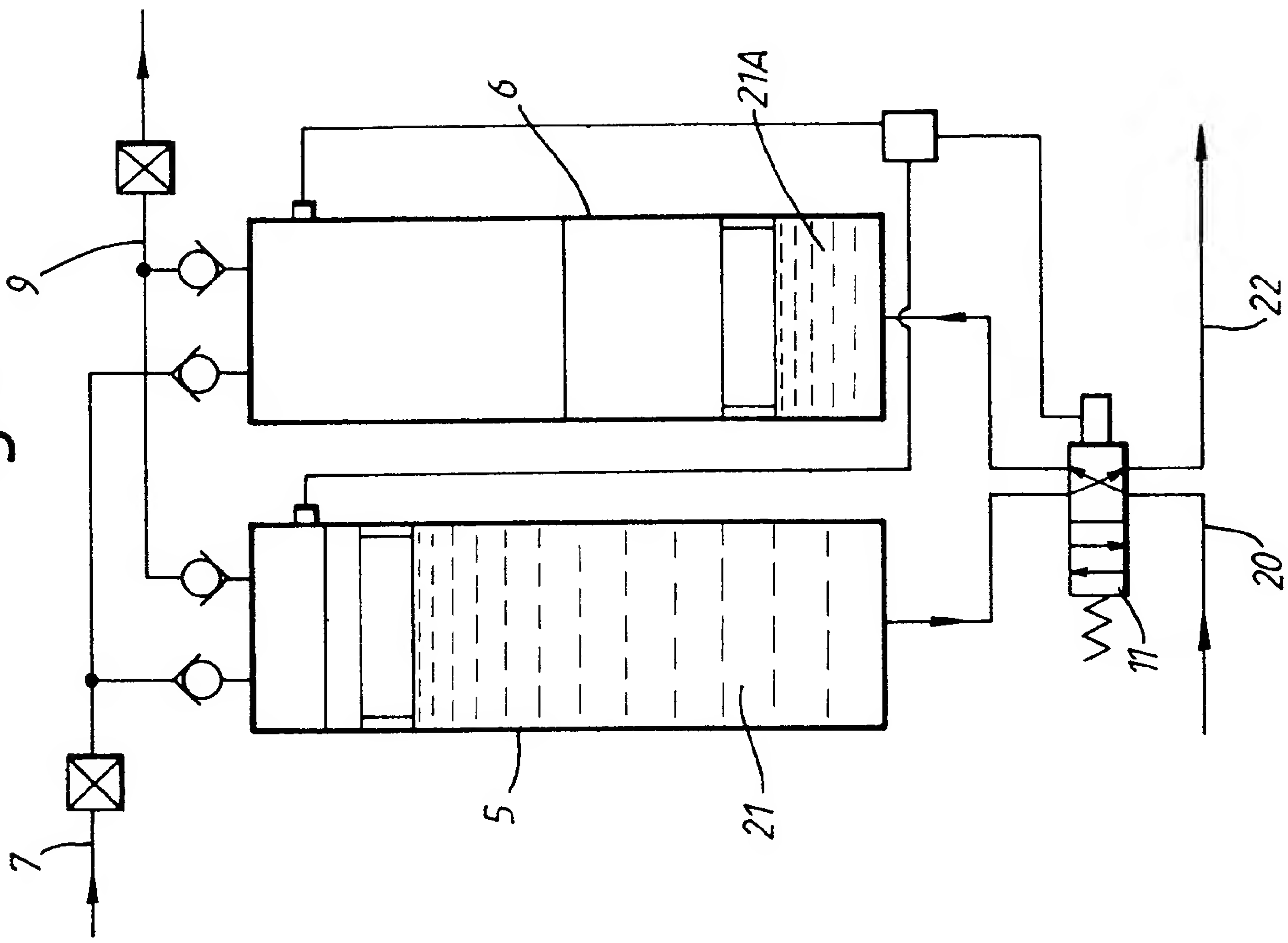
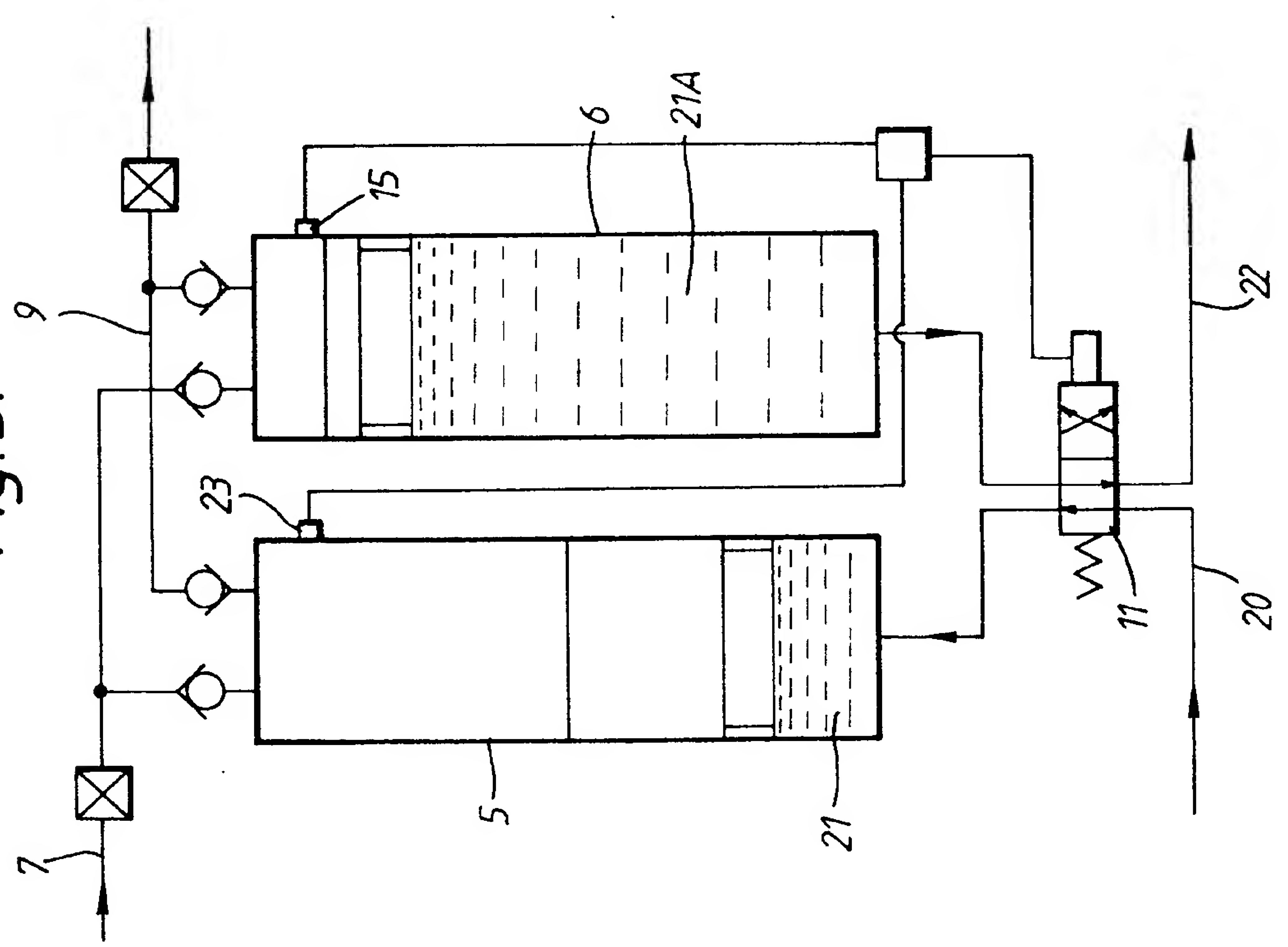


Fig.3.



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EUROPEAN SEARCH REPORT

Application Number

EP 92 30 4172

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X Y	FR-A-550 844 (HARDOLL) * page 1, line 1 - line 18 * * page 2, line 9 - page 3, line 24; figure 1 *	1,2,4 3,6	F04B9/10 F04F1/08 F04F1/10
X A	US-A-2 644 401 (RAGLAND) * column 1, line 51 - column 3, line 11; figures 1,2 *	1,2 6	
X	US-A-3 630 638 (HUSO) * column 2, line 11 - column 4, line 29; figure 1 *	1,2,4,5	
A Y	US-A-1 957 320 (COBERLY) * page 5, line 56 - page 6, line 114; figures 1,4,5 *	1 3,6	
A	US-A-5 073 090 (CASSIDY) * column 3, line 66 - column 5, line 40; figures 4-9 *	1,2,6	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	12 JANUARY 1993	BERTRAND G.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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